REMARKS

Pending claims 18 - 24 have been rejected by the Examiner. By this amendment, Claims 23 and 24 have been canceled and Claims 18, 19, 20 and 21 have been amended.

The 35 USC 112 Rejection

Claim 24 has been rejected under 35 USC 112, first paragraph, as failing to comply with the enablement requirement. In this regard, the Examiner states that Claim 24 recites a "contact surface which is generally annular and includes said lower electrical contact portion and said upper electrical contact portion and further includes another contact surface which generally caps said surface which is generally annular". The Examiner goes onto state that the specification does not anywhere discuss an "annular contact surface, and since the drawings do not show an annular contact shape... It is not clear to which feature the "annular contact surface" refers.

Although Applicants do not necessarily agree with the Examiner's position here, Applicants by this amendment, have canceled Claim 24. Accordingly, the Examiner's rejection is moot.

Drawings

The Examiner, has also objected to the drawings under 37 CFR 1.83(a). In this regard, the Examiner states that the drawings must show every feature claimed and, therefore "annular contact surface" must be shown or this feature canceled from Claim 24. Since Claim 24 has been canceled, this objection is thereby overcome.

Claim Rejection - 35 USC 102

Claim 18 has been rejected under 35 USC 102(b) as being anticipated by U.S. Patent No. 5,579,573 to Baker, et al. The Examiner basically asserts, in this rejection, that Claim 18 reads directly on Baker, et al.

Baker, et al is directed to chip attach. Baker, et al. states that the chip may be, for example, active or passive electronic or microelectronic devices, such as integrated circuits, power transistors, capacitor or capacitor arrays...". It seems clear that regardless of whether the chip is an active or passive device, it is still in chip-form. This is shown, for example, in Figure 2 and, as stated in Col. 3, lines 24 et seq., "the pre-dispensing of the undercoat material 12 can be performed directly after the wafer sawing operations".

In this regard, the preformed undercoat material comprises a high temperature thermoplastic materials which is activated after interconnection of the chip to the substrate so as to form an electrical interconnection bond. Baker, et al. does not use a

noflow resin which includes flux for eutectic solder formation and a resin so as to form an epoxy-based underfill encapsulant with flux combined into a one part epoxy system.

Claim 18 distinguishes over Baker, et al. in several respects. Claim 18 calls for a passive SMD having two electrical contacts (emphasis added). Baker, et al. attach chips to their substrate not a SMD. Typically, SMDs distinguish from chips in that they are two or more terminal passive devices not embodied in semiconductor material with solder bumps on the bottom surface but are rather conventional lumped parameter device structures with contacts at the ends thereof.

Claim 18 further distinguishes over Baker, et al. in that Baker, et al. fail to teach or suggest that a "resin forms fillets around said passive SMD solder connection" (emphasis added).

Although Applicants believe that Claim 18 distinguishes over Baker, et al., as presented, in order to even further distinguish over Baker, et al., Applicants have amended Claim 18. As amended, Claim 18 recites "a passive SMD having at least one electrical contact at each end thereof respectively bonded by a solder connection to electrical contacts on said substrate, said passive SMD encapsulated by a noflow resin such that the spaces between said passive SMD and said substrate is filled with said resin and said resin forms fillets around said at least one electrical contact at each end thereof and said passive SMD solder connection".

The Baker, et al. chip arrangement does not have "one electrical contact at each end thereof" but rather has electrical contacts in the form of "bumped pads" (Col. 3, lines 23, et seq.) on the flip or bottom side of the chip. In addition, Baker, et al. does not teach

or suggest that "said resin forms fillets around said at least one electrical contact at each end thereof and said passive SMD solder connection.

The 35 USC 103 Claim Rejection

Claims 18 - 24 have been rejected under 35 USC 103(a) as being unpatentable over U.S. Patent No. 6,238,223 to Cobbley, et al. in view of U.S. Patent No. 5,128,746 to Pennisi, et al.

The Examiner essentially holds, in regard to this rejection, that Cobbley, et al. disclose all of the claim limitations except Cobbley, et al. fail to "disclose that the resin fills the space between the SMD and the substrate, such that the resin forms fillets around the SMD solder connection". The Examiner also states that "Cobbley further fails to disclose that the resin is formed from an epoxy-based flux encapsulant".

To meet these deficiencies, the Examiner relies upon Pennisi. The Examiner holds that "Pennisi teaches that an underfill resin should be applied in such a manner that the resin completely fills the area between the SMD and substrate (Col. 2, lines 30 - 50), and further forms fillets (260) around the SMD solder connection (figure 2; Col. 3, lines 45 - 50). Pennisi further teaches that the adhesive resin is an epoxy-based flux encapsulant (Col. 3, lines 5 - 15)".

The Examiner concludes that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the structure of Cobbley, such that the underfill resin is formed from an epoxy-based flux encapsulant that completely fills

the space between the SMD and substrate, forming fillets around the solder connections, as suggested by Pennisi".

The Cobbley Patent

Cobbley is directed to a method of applying a dispersion of particles of a thermoplastic polymer in a liquid medium onto semiconductor wafers, dies, lead frames and printed circuit boards, for example, to form bonding layers, pads and bumps. Cobbley describes an arrangement (Figure 1) wherein a device 10, having solder terminations 12, is mounted on a printed circuit board 14 by nonconductive thermoplastic bonding layer 15. The nonconductive thermoplastic bonding layer 15 holds device 10 in place for subsequent processing (e.g., solder reflow). Cobbley shows what appears to be a two terminal SMD being attached to a substrate. In Figure 6 Cobbley also shows a flip chip attach arrangement.

The Pennisi Patent

Pennisi describes a process wherein an adhesive material including a fluxing agent is applied to either a substrate having a metallization pattern or a solder bumped electrical component. Pennisi uses the adhesive material with flux, as is known in the art and described in Applicants' specification as Background and Prior Art, to attach a chip to a substrate. Pennisi uses this approach to facilitate completely filling the small gap between die and substrate to eliminate voids and the like. Pennisi does not disclose using

the adhesive material with flux to attach a passive SMD having at least two electrical contacts.

Applicants' Invention

Applicants' invention is directed to using noflow type of encapsulants for passive SMDs. Applicants recognize that the conventional approach to attaching SMDs to substrates has resulted in shorting problems. As stated on page 2 of Applicants' specification, "one of the difficulties with conventional approaches... is that the solder reflow or dipping process typically may leave flux residues in the gap between the SMD and substrate during joining". In addition, contaminants may enter the gap. As further pointed out, "testing has shown that devices may fail as a result of the above conditions" and that failure, at least in part, "is due to the fact that the metallurgy of the electrical contact joints can grow dendrites on the surface of the SMD or substrate in the gap region" and that the "dendrites can electrically short the opposing the opposing electrical contacts of the SMD".

Heretofore, noflow encapsulants were used to facilitate attachment of chips to substrate. As pointed out by Pennisi in Col. 2, line 29, et seq., "the very small gap between the die and the substrate must be completely filled in order to provide maximum environmental protection for the device".

Applicants, in recognizing the dendrite shorting problem in prior art attachment of passive SMDs to a substrate, have discovered that use of the noflow type of enapsulant for attaching passive SMDs to a substrate not only acted to completely fill the gap

between device and substrate, but also created a structure in the form of fillets around the passive SMD solder connections.

The Cobbley/Pennisi Combination

Neither Cobbley nor Pennisi teach Applicants' fillets structure. As previously stated, Cobbley teaches applying a dispension of particles of a thermoplastic polymer in a liquid medium onto wafers, dies and like devices for attachment to a substrate. The approach used by Cobbley fails to completely fill the gap between device and substrate and fails to form fillets around solder connections.

Pennisi, on the other hand, teaches using an adhesive material including a fluxing agent to attach solder bumped electrical components to a substrate (Col. 2, lines 56 et seq.). As pointed out in Col. 3, lines 53 et seq., "embodiments using other types of surface mounted components having solder bumps are within the scope of the invention". From this and other statements in Pennisi, it is clear that Pennisi is directed to attaching solder bumped chip type of structures to a substrate using an adhesive material including flux, and this is what Pennisi shows in their drawings.

Given the teachings of Pennisi as related to solder bump interconnections, Applicants do not agree that one skilled in the art would be motivated to combine the Pennisi teachings to the teachings of Cobbley in regard to passive SMD attachment to substrate. In this regard, Pennisi does not teach the formation of fillets and to the extent that one might argue they do, they do not form fillets around the solder connection of a

passive SMD. Forming fillets around the solder connections of an SMD solves quite a different problem from any suggested by Pennisi.

Again, given the disparate teachings of Cobbley and Pennisi, Applicants do not agree that one skilled in the art would be motivated to combine these references. In this regard, it appears that the Examiner, in combining Pennisi with Cobbley, is relying upon Applicants' teachings in an effort to construct a device to anticipate Applicants' claims.

Claim Distinctions

Although Applicants firmly believe that the claims, as originally presented, clearly distinguish over all of the art relied upon by the Examiner, in order to even further distinguish over this art, Applicants have amended Claims 18, 19, 20 and 21. Applicants have previously pointed out the distinctions of Claim 18.

Claim 21, as now presented, recites "a passive SMD having at least two electrical contacts each having at least a lower electrical contact surface and an upper electrical contact surface at the terminus thereof with at least said lower electrical contact surface of said at least two electrical contacts of said passive SMD respectively positioned toward said at least two electrical contacts of said substrate and with said at least said lower electrical contact surface and said upper electrical contact surface at the terminus thereof of said at least two electrical contacts each respectively bonded by a solder connection to the said at least two electrical contacts on said substrate such that said upper contact surface is covered by said solder connection".

Neither Cobbley nor Pennisi, either alone or in combination, teach or suggest such recited structure.

Claim 21 further recites "said passive SMD encapsulated by a resin such that the space between said passive SMD and said substrate is filled with said resin and with said resin further forming fillets around each said passive SMD solder connection including forming fillets covering said solder connection covering said upper contact surface". Again, neither Cobbley nor Pennisi, either alone or in combination, teach or suggest such recited structure.

Conclusion

In view of Applicants' amendment and remarks, Applicants firmly believe that the application is now in condition for allowance. Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the outstanding rejections, allow the claims as now presented, and pass the case to issue.

Respectfully submitted,

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